PNEUMATIC MASSAGE

IN

AURAL PRACTICE

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At a meeting of the Sixth International Otological Congress, held in London, August 11, 1899, the Lenval prize was awarded to Dr. Charles Delstanche, of Brussels, on account of his devices for oto-pneumatic massage which were regarded by the jury as being so material an assistance in the practical treatment of affections of the middle ear as to merit this award.[1]

No stronger indorsement than the above could be desired as to the recognized merit of pneumatic massage in aural practice.

In the consideration of this subject it becomes necessary to briefly investigate all forms of massage employed in the treatment of diseases of the ear, of which pneumo-massage may be said to be the middle register, with the pressure probe as bass, and phone-massage as high register. They each have their proper field. Lucae[2] has for years advocated the use of the pressure probe. Lester[3] has modified this method by having the pressure probe attached to, and operated by a tiny electric motor, so as to give a rapid, short stroke, 1-16 inch from center, for from three to ten seconds. In pronounced cases wherein the ossicles are firmly bound down by adhesive bands, Bishop[4] has employed an ossicle fork, one prong of which is introduced back of the handle of the mallet through a previously made slit in the drum head, while the other prong is outside thereof, and thus strong enough traction is made to break up the adhesions.

As air is the natural medium for conducting sounds through the auditory canal to the middle ear, it would seem most rational to make use of pneumatic massage which, in its simplest form, is done by producing suction with the moistened finger tip applied to the external opening of the auditory canal,

Hand massage, as with a Siegle pneumatic speculum or a Delstanche masseur, has been extensively employed by different otologists, and particularly by those who have found that the results from hand massage were equally as good as, or even better, than when such mechanical devices as were available had been used. In this progressive age, wherein machinery is supplanting hand labor in so many fields, it seems apparent that a properly constructed device, which perfectly gives the several modifications of the massage air current, should easily supplant manual treatment which, of necessity, cannot be administered without variation or fatigue during a seance of several minutes' duration. Furthermore, the doctor's time is too valuable for him to be doing in a mediocre manner that which a properly constructed machine can do much better than he possibly can. The therapeutic effects to be obtained all hinge upon the mechanical details whereby all possible variations of the air current can be produced.

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The electric current for medical use is gauged and regulated by means of the milleampmeter, the pole-changer, rheostats, rheotomes, and transformers in order to secure all of the available physical properties and variations thereof. In like manner in order to secure the maximum results to be derived from pneumatic massage it is necessary for the mechanic to first furnish means for securing all of the desirable physical properties of the air column or current employed, which may be summarized as follows :

A. The character of the air current.
   1. Continuous aspiration.
   2. Aspiration with release.
   3. Simple vibration.
   4. Compression with vibration, using *a*. Plain air; or, *b*, Medicated nebulæ.
B. The length of stroke of the pump piston.
C. The rapidity of the strokes.
D. The force or gentleness of the stroke—which latter is secured by the use of an air rheostat.
E. The amount and character of the accompanying noise (phone massage).
F. The length of the seance of treatment.
G. The frequency of repetition of treatments.
H. The duration of the course of treatment.

In considering the Character of the Air Currents employed, the one noted as that of simple vibration (No. 3) is the one which has been most often employed. The one mentioned as that of aspiration with release (No. 2) is one whereby successive rarefactions are intermittingly produced, but without alternate compressions as with the preceding current. In other words, after each suction from the upward stroke of the pump piston, a valve is released so that the downward stroke operates freely upon the outside air. In this way after the drum head is drawn forward by suction it returns by its own elasticity. This current should not be used at a greater rate of speed than 150 V per minute, for when above this rate it "loses its distinct exhausting and releasing character, and the two begin to run together, owing to the elasticity of the air,"[5] and it thus becomes a continuous aspiration. For its primary and principal use the slower vibrations, 30 to 90 V, can with the greatest advantage be employed. When this current is being used, the patient should be directed to swallow every few seconds. By having this current available there is never any necessity of "starting on the exhaust stroke," the importance of which has been so frequently mentioned by different writers, for when using the simple vibratory current the stroke should be so short that the position of the piston is immaterial. The current of continuous aspiration (No. 1) is employed in suppurative otitis after the perforation has taken place, and care should be given that the stroke is neither too long nor too rapid.

The last current, designated as that of compression with vibration, (No. 4) is the ordinary air pump, the air current from which can, if desired, be medicated by being made to pass through a hand nebulizer and can then be employed either for inflation through an Eustachian catheter, thereby giving intra-tympanic massage, or to force a nebula inwardly through the external auditory canal in chronic suppurative cases, wherein the drum head is freely perforated, as has been advised by Stillson.[6] For this use a long, rapid stroke is required.

The Length of the Stroke of the pump piston varies with the air current being

used and should be shortest with the simple vibratory current. It should at no time be of sufficient length to cause discomfort to the patient, and should generally bear an inverse ratio to the speed being used, viz.: the stroke should be shortened as the rapidity thereof is increased. With the aspiration with release current a long stroke will be tolerated and with the compression current both a long and rapid stroke will be required in order to produce a nebula.

The Rapidity of the Strokes. As is elsewhere elaborated it is only the slow stroke that produces true massage and its effect is chiefly operative upon the conductive mechanism. As the speed is increased, the stroke meantime being shortened, its effect extends more to the labyrinth, though when ossicular rigidity is marked, in combination with an atrophied drum head, the rapid jar of the short stroke tends to produce ossicular movement far more than would a long, slow stroke and is furthermore not damaging the drum head.

The Force or Gentleness of the Stroke. Plumbers make use of an air cushion in order to avoid the noisy jar which would otherwise occur when the outlet valve at the washstand is suddenly closed. In the same way the force of a vibrating air current can be modified by the introduction of a similar device. I have for several years made use of a hard rubber piston syringe,[7] which is attached to the ear piece and through which the jar of the air current can be lessened at will by withdrawing

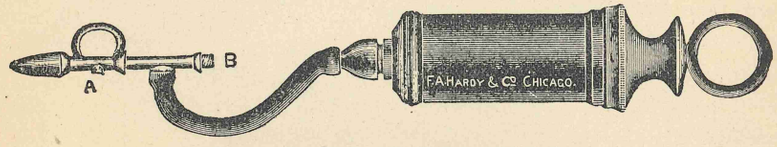


Fig. 1. Oto-Pneumatic Masseur (½ size).

the piston so as to increase the amount of imprisoned or residual air. Another material advantage derived from its use is that of slow and forcible exhaust in order to overcome the drum-head retraction in combination with the rapid vibrations.

Stillson[8] has described a similar device whereby the drum-head is "held forward by the elastic expansion of a soft rubber ball previously compressed." I have found, owing to the unavoidable leak in an apparatus of this kind, that a continuous rarefaction cannot be maintained, and hence the operation of the piston syringe gives far better results. On the exhaust stroke the hole (A. Fig. 1) is closed by the operator's finger, while on the down stroke this hole is left open. This device is used only with the simple vibration air current and is attached to the pump hose at B. While in the illustration a fitting for only one ear is shown it will give an economy in time if a double ear-piece, like a bin-aural stethoscope, is employed when both ears are to be treated. In such case the exhaust syringe had better be attached at the point of bifurcation.

In order to produce an even pressure when using an electric masseur, Lucae punctures the rubber tube close to the ear by making a small hole with a red-hot needle.[2] Inserting the ear-piece loosely in the ear is another method whereby the force of the pump stroke has been softened. Neither of these methods would seem to be as exact as is the use of an air rheostat

The Length of the Seance of Treatment varies with the sensitiveness of the patient and may range from ten or fifteen seconds up to several minutes. Lautenbach[9] reports the use of massage in one case twice daily, three hours at each treatment, and continued for five days when she "heard a clock at over two inch-

es." In acute cases the seance should be brief, while in old "chronic-non" cases a treatment extending from fifteen to thirty minutes is to be recommended.

The Frequency of Repetition of Treatments. In acute cases, and at the beginning of a course of treatment in old or chronic cases, a daily seance is to be advised, which, after a while, may be changed to every second, and later to every third day, though if the matter of expense is of no importance with the patient, daily treatments had better be continued in order to insure the greatest progress.

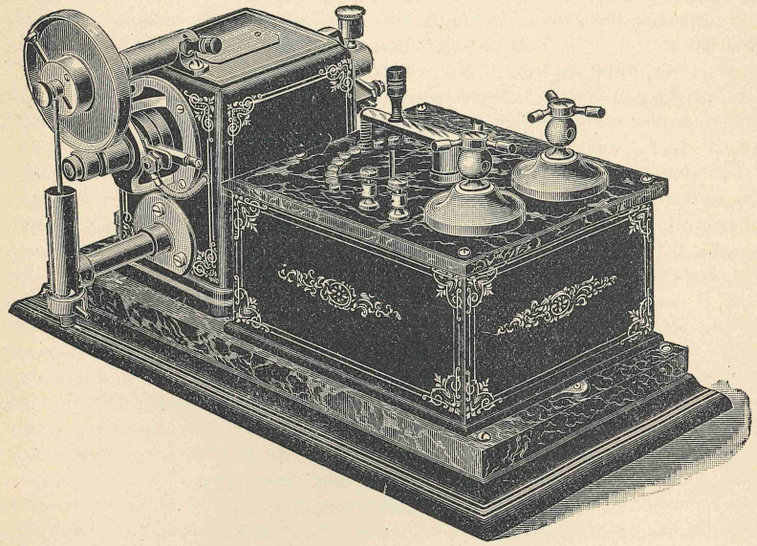
The Duration of the Course or Treatment is only to be considered with chronic cases as acute cases will naturally discontinue when they recover. In case of the former the results should be noted every two or three weeks and treatment persevered with as long as progress is being made, which is often so gradual as to require several months' time. A return to treatment should always be earnestly advised when any degree of retrogression is detected after a period of discontinuance.

As writers upon the subject of mechanical oto-pneumatic massage have generally been remiss in not giving the several minor details which are so essential for its proper use, I have taken the liberty of enumerating the more important features. Furthermore, in order to show the different practics of different practitioners, I will tabulate the deductions of a few who have been sufficiently clear to quote as regards these matters of detail.

AUTHOR	Length of Stroke.	Strokes Per Minute.	Length of Seance.	Repetition.	Duration of Course.
Stevenson, (10)	¼ to 1¼ inches.	30 to 60	Up to 30 min.	?	?
Lautenbach, (11)	½ in. and 1 in. (?)	40 to 300	20 min. to 3 hours.	Daily or less often.	3 Mos.
Jackson (5)	½ in.	100 to 200	15 to 30 seconds.	3 times weekly.	?
Seiss (12)	Up to 1 in.	60 to 720	?	Daily or less often.	2 to 4 Weeks.
Ostmann, (13)	2 to 4 m m	600 to 1200	10 to 25 min.	Daily.	3 Mos.

While I have for several years been employing pneumatic massage through the use of both mechanical and hand exhaust devices, I have been constantly appreciating their shortcomings and have thereby been led to believe that the results derived from such treatment might be more uniformly beneficial were the several patent deficiencies in the devices used suitably overcome. I have recently succeeded in inducing the VICTOR ELECTRIC CO. of this city to so modify their excellent pneumatic massage pump that it will comply with the requirements previously outlined. Furthermore, the means adopted for instantly separating the pump from the motor, by the simple swinging of a lever, which operates an eccentric axle, greatly improves the outfit as a cautery transformer, and when the use of the pump is again desired, by swinging the lever back, the pump starts at the same length of stroke as existed before the disconnection.

The Length of Piston Stroke can be varied from 0 to 1¼ inch, and the exact length of stroke desired can be selected by a gauge attached to the crank-pin. The rapidity of the piston stroke in my apparatus varies from 30 to 600 V per minute, though, owing to variations in the voltage of the electric current by which the motor is operated and, furthermore, to variations in the diameter and the quality of



No. 2. TRANSFORMER WITH EAR PUMP.

the wire used as resistance in the transformer, a slight variation in speed will always be observed when comparing the several motors made at one time, all of which were intended to be alike.

It is principally in the treatment of the so-called "chronic-non" cases—the non-suppurative catarrhal otitis with ground-glass drum-head, which is so often the forerunner of sclerosis, wherein pneumatic massage is indicated, to improve the hearing and addditionally to control or diminish the accompanying tinnitus which is probably most often due to labyrinthal pressure and has been tritely compared by Spear[14] with the "seeing of stars when the eye is pressed," as tinnitus is produced whenever the tension within the labyrinth becomes greater than normal from pressure within, or from changes in the external ear, or the middle ear, with pressure from without. Vertigo, another symptom occasionally complained of, is also at times a result of pressure. Through its favorable effect upon the cause—middle ear adhesions, etc.—pneumatic massage is often beneficial in both of these conditions. It also assists greatly in the correction of itching of the external auditory canal and, furthermore, is generally instrumental in increasing the secretion of wax when the canal has become too dry, both conditions being concomitant

with chronic catarrhal otitis media. Additionally, in hypertrophic cases, inflation by the Politzer method soon becomes more easy of execution.

In the treatment of middle ear cases the aim should be to cause the defective ear to assume, as far as possible, the physical character of the normal ear, and most important of all to increase the ossicular mobility. Passive flexure of ankylosed joints in other localities being the most valuable method of treatment, it would seem reasonable that a similar treatment, suitably modified to conform to the local conditions, would give the greatest promise of benefit. In addition to causing motion of the ossicles by breaking up adhesions, and absorbing hyperplastic deposits, massage stimulates and improves the circulation in all of the middle ear structures, thereby increasing the nutrition thereof. For this latter effect the short, rapid, simple vibratory stroke is more efficient.

As forcibly stated by Jackson[5], pneumo-massage "frequently arrests the onward march of a progressive difficulty of hearing even if an absolute cure is not established * * * and offers good chances of benefit in all cases due to defect of the sound-conducting apparatus, whether the result of purulent or catarrhal otitis media, and whether acute or chronic, hypertrophic or hyperplastic." In a general way those who hear better in a noise (paracusis Willisi) are benefited by pneumatic massage. Seiss[12] states that senile deafness can be retarded almost indefinitely.

In cases of this class the conducting mechanism is primarily at fault, hence the trouble is essentially in the middle ear, though the labyrinth is quite prone to becoming secondarily affected to some degree. In these cases the chief objective symptom under ocular inspection is impaired mobility of the ossicles, associated with more or less dullness and thickening of the drum-head, which is also ofttimes retracted. It is in cases wherein the drum-head is most dense that pneumatic massage with long slow vibrations is of most value. On the other hand when the m. t. is thin or atrophied, suction may add to the trouble without moving the ossicles, hence in this condition a very short and rapid stroke should be employed.

As regards the value of pneumatic massage in acute inflammatory troubles of the middle ear authorities differ. On the one hand Seiss thinks it contra-indicated in cases accompanied by any active inflammatory process. In similar conditions Burnett[15] advocates maintained rarefraction with a Siegle pneumatic speculum so as to thus maintain traction upon the m. t. and its tensor. Lautenbach[3] uses vibratory suction in acute cases as soon as possible in order to avoid adhesions.

Pneumatic massage has proved of value in suppurative conditions of the middle ear, particularly in cases of long standing, and when employed in addition to the usual line of treatment, will often greatly expedite a cure, owing to its mechanical effect in jarring or drawing down discharges from the attic. In the treatment of this condition either the continuous aspiration current or the aspiration with release current should be employed with a piston stroke of such length and force as to not cause annoyance to the patient, and continued for about five minutes. Following this, and later on when cleansing is less required, the strokes may be shortened and the rapidity increased so as to give greater stimulation, say ⅛ inch simple vibration at 300 V for thirty seconds or longer. In recent cases of suppurative otitis media, *after perforation of the drum-head has been produced*, a very short, slow vibratory stroke may prove beneficial in the way of shortening the period of discharge and by preventing the adhesive formations which are so prone to occur.

For the welfare of the patient all other well-known methods of treatment should

be simultaneously employed, as care for hygienic surroundings, general medication when indicated, tympanic inflations, and particularly an aggressive attack upon any and all malconditions of the nose and upper throat which may be present, in order to correct the chronically inflamed or catarrhal condition of the mucous membrane of the nasal passages and fauces, which, through continuity of tissue, is such an important etiological factor in a very large majority of all ear diseases. It is after the correction of the nasal and faucial abnormalities when pneumatic massage *added to the other treatment* may give the most favorable results.

As the cause of all sounds heard by the ear is due to motion noises, as of musical instruments, etc., have been employed to secure motion or vibration of the drum-head and ossicles, such process being known as phone-massage. Reports upon the use of phone-massage alone have been quite varied and, upon the whole, unfavorable. This is quite likely in part due to the character or unnatural combination of sounds so often employed. Those who have had most experience therewith do not use phone-massage alone, but generally in combination with pneumo-massage.

It would seem rational to expect most of phone-massage in the treatment of labyrinthal deafness; though as such cases are almost invariably complicated by or secondary to middle ear trouble, it is easily surmised why phone-massage alone should often prove to be disappointing. There is a necessity, in case of labyrinthal deafness, to consider its character or cause:

1st. When independent of middle ear trouble, the cause being central or local, from brain or nerve lesions due to systemic, toxic or other causes as intra-labyrinthal hemorrhage or traumatism, which class of cases is rarely met with and properly constitutes less than 5 per cent of all cases in which the labyrinth is perceptibly involved.

2nd. When secondary to or associated with middle ear trouble:

A. Cases in which inflammation has not been a causative factor:

1st. Result of exhaustion.

2nd. Result of non-use (as with the deaf-dumb).

B. Cases in which middle ear inflammation has been a factor causing:

1st. Inflammation by extension.

2nd. Compression.

It thus becomes apparent that no heterogeneous combination of sounds will give promise of benefiting the labyrinthal end of the deafness present. Cases coming under the first heading are not benefited by any form of massage treatment, and with those coming under the second heading, a suitable form of phone-massage should be selected for each sub-division, though only in combination or alternation with pneumo-massage. From a theoretical standpoint it would seem that for boiler-makers' deafness, a repetition of musical airs would give most promise of benefit and that to educate the dormant nerves of the deaf-dumb, either the human voice through a speaking tube or the phonograph would be the most practical. It is essential in all cases that the interest of the patient should be kept active by either the selection of recognized tunes or by the employment of speech. Phone-massage if too long continued, or if the notes are too shrill or too powerful, will prove exhausting to the auditory nerve and may possibly cause labyrinthine hemorrhage. I have had no personal experience with mechanical devices for the production of uncombined phone-massage.

Of course with any mechanical device for the production of pneumo-massage

there is unavoidably present a certain amount of noise, which becomes more pronounced as the speed of the motor increases, the effect of which is undoubtedly, at times, unfavorable, and may explain the lack of improvement sometimes observed when mechanical pneumo-massage has been employed. The practical absence of noise in the giving of massage treatment with the Siegel device is, to my mind, the principal advantage in its use. Should, in future, a method of eradicating noise from mechanical pneumo-massage be devised, it will be an undoubted advantage, though the regular and unvarying character of the noise as at present exists is the least disadvantageous and in the most perfectly constructed pumps is reduced to a minimum. Such noise may, in fact, at times be an advantage. In this connection attention must be called to the pneumatic otoscope of Bishop[4] with which either gentle or powerful hand-massage can be given, even better than with the device of Siegle, and additionally if desired in combination with a magnified view of the parts being treated.

In order to watch the effect upon the m. t. a pneumatic speculum can be used as the ear-piece, and such practice is particularly advisable during the first few treatments, or until the tolerance of the patient is learned. It is only the slow vibrations that can be seen and counted. Above 150 V they run into each other and lose their individuality. A faint reddening of the drum-head is an indication to discontinue. A treatment "should never cause pain, vertigo, echymosis, or increase tinnitus; if so, it has been too vigorous."[12] Old cases, with tough and thickened drum-head, will stand the greatest dosage, though tolerance in most cases will increase as the course of treatment progresses.

As regards the application fo pneumatic massage in aural practice, it may be said in a general way, when addressed more particularly to the middle ear, that slow vibrations with but little noise are of the greatest value. Whenever greater speed is employed, its effect reaches more to the labyrinth and this is furthermore favored by the increase of noise due to the more rapid motion of the engine. In order to secure the greatest range of therapeutic action, it is essential to be able to command a stroke ranging from the merest tremor, say 1-16 inch up to 1 inch or more: and as regards speed, from 30 or 40 V per minute up to 600 V or more.

The conclusions to be drawn are that slow vibrations (30 to 90 V) are generally best adapted to middle ear troubles; that more rapid vibrations (300 V and over) have a more pronounced effect upon the labyrinthal nerves; and that improvement of middle ear conditions will have a favorable effect on the labyrinth in those cases in which trouble of both the middle and inner ear co-exist.

Columbus Memorial Building.

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